Lakes Environmental Association

2023 Winter Monitoring Report

LEA's Winter Lake Monitoring

Introduction

For decades, Lakes Environmental Association (LEA) has watched over the water quality of lakes in the greater Bridgton area by making measurements and collecting water samples during late spring through early fall. Wintertime was mostly ignored due to challenging work conditions and the long-held perception that lakes are dormant during the cold, ice-covered period. More recently, the scientific community has challenged that perception through a growing number of studies that highlight the importance of evaluating winter-time lake conditions and linking those to overall lake health.

Climate change plays a large role in the increased interest in winter lake conditions. Long-term records of lake freeze and break-up dates show that ice cover periods have decreased significantly for many places. Less time with ice cover has and will lead to a reduction or loss of cultural and recreational activities. The impact on water quality throughout the year from a reduction or loss of ice cover is not as well known. So to fill that void, researchers have increased efforts to study lakes during winter and improve basic understanding of winter conditions and how those might link to open water periods.

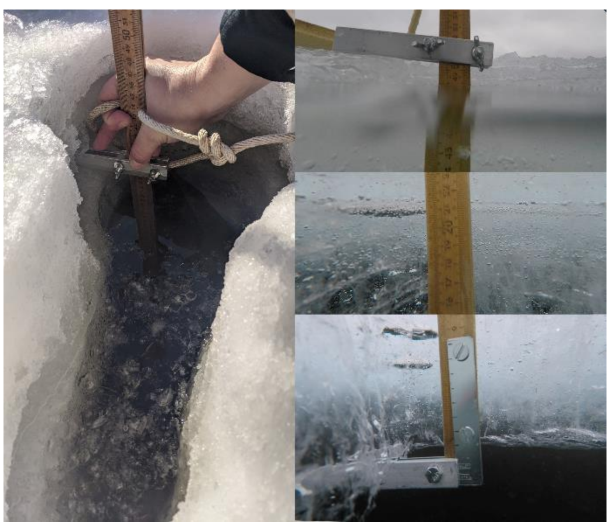
LEA has joined in that effort to make wintertime field work a more regular part of lake monitoring. Our staff began detailed winter field work in 2018 with nine trips to a total of four of our service-area lakes. The total trip number doubled in the next year with six lakes visited. We made 13 trips with 7 different lakes in 2020, 29 trips with 11 different lakes in 2021, and 32 trips with 13 different lakes in 2022.

This report summarizes data gathered during the winter 2023 field season. Partial support for this work was provided by the Five Kezar Ponds Watershed Association, Hancock & Sand Ponds Association, the Keoka Lake Association, the Keyes Pond Environmental Protection Association, the McWain Pond Association, the Moose Pond Association, the Peabody Pond Association, the Trickey Pond Environmental Protection Association, and the Woods Pond Association. Thanks also go to Rebecca Gould and Bill Buckley, Ann and Dan Lasman, Bob Mercier, Ken Sharples, and Camp Tapawingo for providing lake access.

Methods

We made two visits each to Back Pond, Hancock Pond, Highland Lake, Keoka Lake, Keyes Pond, Long Lake (north basin), McWain Pond, Middle Pond, Moose Pond (main basin), Peabody Pond, Sand Pond, Trickey Pond, and Woods Pond. For each lake visit, we traveled by foot over the ice to the deep site and used an ice auger to drill a hole. Holes were widened using an ice saw or by drilling an extra hole in order to accommodate larger gear. We used a homemade gauge to measure ice thickness, snow depth, and water level in the hole. We also captured video footage of the ice and under-ice conditions for each lake using a GoPro camera in a waterproof housing. Staff involved in these trips included Maggie Welch, Ben Peierls, Shannon Nelligan, and Michael Flannery.

Maggie with ice auger (left) and fitting Secchi disk through expanded ice hole (right).



Ice gauge in use (left) and as seen under water (right).

We measured light levels above and at several depths below the ice using a LI-COR LI-192 underwater quantum sensor. During these measurements, we covered the hole with three layers of window screening to keep sunlight from passing straight through and affecting the under-ice readings. The attenuation of light due to ice was calculated as the percent of surface light that reaches the water just under the ice layer. Water clarity below ice was measured during each visit using a Secchi disk lowered through the hole and viewed with our standard slanted-glass viewing scope.

We used a calibrated YSI EXO2 multiparameter sonde connected to a handheld data logger to measure depth profiles of temperature, dissolved oxygen, and chlorophyll fluorescence; the sonde also measures conductivity, pH, and turbidity, but these data are not included in this report. Sonde depth was converted to and reported as depth below ice. Measurements were recorded every 0.5 or 1 meter to the bottom (determined by feel or when turbidity levels rose an order of magnitude).

Maggie calibrating the sonde.

Water samples were collected using flexible tubing (known as a core tube), which integrates water from the ice to 10 m depth (or to 1 m above the bottom in shallow lakes). These samples were analyzed for total phosphorus using a SEAL segmented flow analyzer, for chlorophyll-a by chemical extraction and fluorescence, and for algae using a Yokogawa Fluid Imaging Technologies FlowCam, a flow imaging microscope that captures images of algae for counting and identification.

Maggie using the sonde and handheld data logger and Shannon using the light meter on Middle Pond (left) and Maggie measuring Secchi depth on Keyes Pond (right).

Shannon measuring light above the ice on Keoka Lake (left) and using a core tube with Ben to collect water samples on Woods Pond (right).

Overall Results

Ice cover is the dominant feature of LEA service area lakes during winter. Variation in ice cover timing, duration, and characteristics (known as ice phenology) is driven by local weather conditions. Above-average temperatures in December and January meant ice-in was later than usual, and many of lakes were not completely ice covered until about mid-January. We waited for safe ice before beginning field trips in late January to early February. Measured **ice thickness** ranged from 16.5 to 41 cm (6.5–16.1 in; Fig. 1), with the maximum occurring on Middle Pond. This was one of the lowest compared to maximum ice thickness of 55, 75, 41, 57.4, and 53.7 cm for 2018, 2019, 2020, 2021, and 2022, respectively. In February on Middle and Woods Ponds, the ice was punctuated by an unusual number of holes, possibly caused by sediment gas bubble release. Other than Keoka Lake (which was sampled earlier in the year than other waterbodies), ice thickness generally varied by a small amount between visits. The slow start to the season, periods of warmer than normal temperature, and concerns over ice safety meant we made our second visits earlier than usual. Most lakes were free of ice by mid-April.

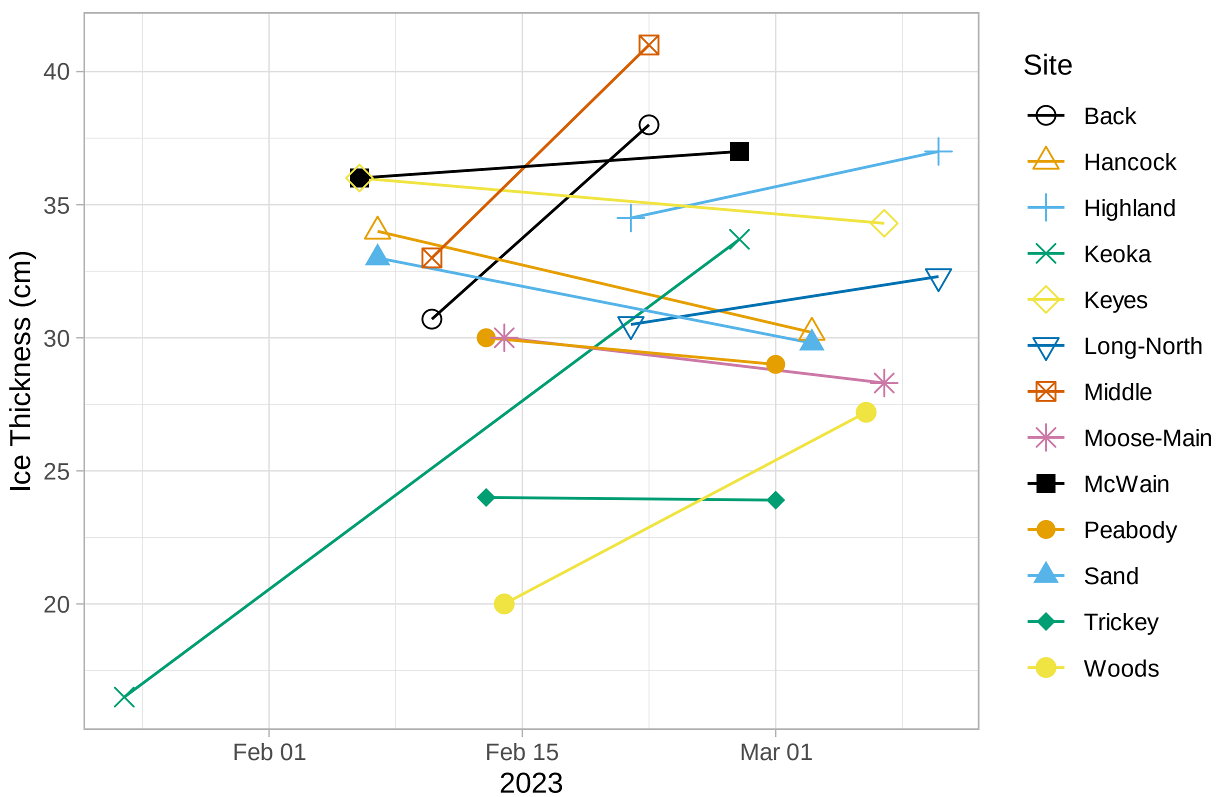


Figure 1. Ice thickness in cm versus date for lakes visited in winter 2023; lines to aid visualization only.

A common method for assessing lake condition is to collect depth-specific physical, chemical, and biological measurements. The resulting sonde-based measurements (or profiles) gave us a snapshot of lake stability and mixing, oxygenation, and algal biomass throughout the whole water column at specific points in time.

Temperature: The most significant feature captured in these profiles is the inverse temperature stratification typical of ice-covered lakes. Water is most dense at 4 °C (39.2 °F), so in winter the warmest water is at the bottom and the coldest water is at the surface (ice-water interface), opposite of the summer pattern. Temperatures typically increased rapidly with depth within the first meter or so, and then increased more slowly to the bottom. Sometimes there was little change with depth indicating mixed conditions. Water heated by the sun through the ice then sinks and is replaced in what is called convective mixing. Heat stored in the sediments over the summer can also increase water temperature, especially at the bottom.

Dissolved Oxygen (DO): Microbial respiration and other oxygen-consuming processes do occur despite the cold temperatures. As a result, DO decreased with increasing depth and time, much like in summer. Near-ice DO concentrations were mostly near saturation, driven by oxygen produced from algal photosynthesis. Two lakes (Keoka Lake and Keyes Pond) had near-hypoxic conditions (DO of 2 mg/L or less) at the bottom and Middle Pond was essentially anoxic (complete absence of DO) in the deepest half meter; these bottom waters would be stressful or lethal habitat for fish and other animals and the anoxic conditions promote phosphorus release from the sediment.

Chlorophyll: Chlorophyll fluorescence profiles represent the vertical distribution of algae, an important part of lake food webs and an indicator of lake trophic status (i.e., how green a lake is). Chlorophyll fluorescence is a relative measure of chlorophyll pigment concentration, which is itself a proxy for algal biomass. The sonde chlorophyll profiles displayed much more variability, but in general when there was a peak in fluorescence it tended occur within a few meters of the ice-water interface and sometimes directly under the ice. Peaks at the bottom were probably sediment-associated dead or dying cells. The variation with depth can be explained by light and nutrient availability and possibly by differences algae species present. Zooplankton (tiny grazers of algae) can also control algae abundance by eating them; we often observed abundant zooplankton populations in the under-ice videos and in the surface water. Fluorescence magnitude ranged as high if not higher than summer values suggesting the presence of an active and productive algal community.

Another key feature of wintertime lake conditions is low **light**. Sunlight controls water temperature and provides energy for photosynthesis by algae. When lakes are covered by ice or ice and snow, light is blocked from reaching the water below. Our field measurements demonstrated that light just beneath the ice layer was reduced from between 50 to 90% of incoming sunlight, with snow cover and the amount of white ice (frozen slush and snow) as strong factors controlling the amount of that reduction. Lake photic zones (where algae have enough light to grow) are usually defined as the layer extending down to where light is 1% of surface light. Winter algal growth, therefore, is often limited to shallow waters due to the effects of ice and snow on light penetration.


Ice holes on Middle Pond.

In addition to ice and snow, water clarity plays a role in controlling light availability in winter. This was our second year measuring **water clarity** by Secchi disk through lake ice. Winter 2023

Secchi depth readings were mostly within the typical range for each lake, though unlike in 2022, all except two values were below the long-term mean. Single readings from Middle, Moose, Sand, Trickey, and Woods Ponds were just at or below the long-term minimum value. These low readings (indicating less clear water) might be concerning if it were not for the fact that other water quality measures (total phosphorus and chlorophyll-a) were not overly high. It is also possible that the true values were biased due to the potential difficulty distinguishing the Secchi disk at depth under the low light conditions beneath ice and snow.

Total **phosphorus** (TP) is a second key indicator of water quality after water clarity. TP values much greater than 12 parts per billion (ppb) indicate an excess of nutrients that can fuel algae growth. Winter sample TP concentrations were a mix of below and above the long-term mean and well within the range of TP measurements for each lake. These samples came from water in the upper 10 m of the lake, but nutrients can build up in bottom waters if conditions permit. We did not collect samples to evaluate this, but in winter 2021 we did measure TP concentrations >20 ppb in the deep, anoxic lake samples.

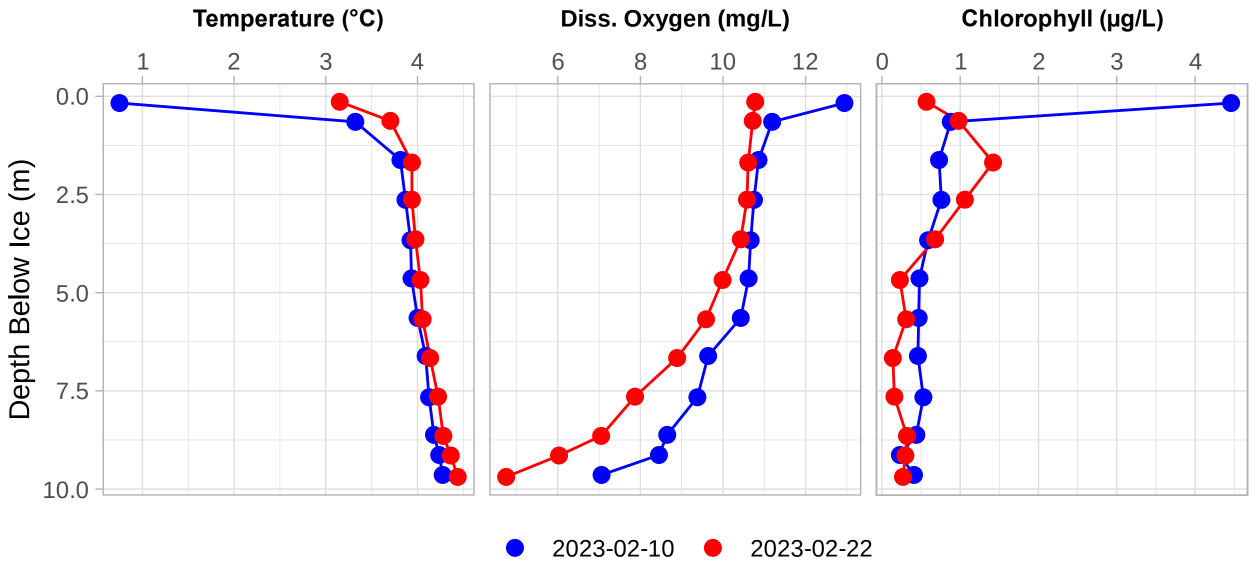
Chlorophyll-a is another key water quality indicator that we measured on winter lake samples. More accurate than the sonde fluorescence values (labeled as "chlorophyll"), chlorophyll-a concentrations are the most direct measure of how productive, or green, a lake is. All the winter lake sample measurements except those for Peabody and Trickey Ponds were below the long-term average concentrations. The above-average chlorophyll-a in Trickey Pond was surprising given its normally clear summer conditions, but those levels were not considered high (≥ 7 µg/L).

We used our FlowCam analyzer to characterize the taxa (species) that make up the lake **algae** community in winter. Example images captured by the analyzer are shown and include members of several taxonomic groups, including diatoms, synurophytes, chrysophytes or "golden brown algae", cyanobacteria, dinoflagellates, and cryptophytes. Several of these taxa are capable of deriving nutrition from organic matter and microbial prey in addition to photosynthesis, which makes sense in the light limited conditions of winter. The FlowCam also captured some images of rotifers, part of the non-photosynthetic grazing community (zooplankton).

Specific lake profiles and water quality results start on the following pages. The two winter-time sampling trips allowed us to capture typical conditions and also some of the changes that happened throughout the season on each lake. With multiple years of winter data, we now can start examining the data for changes over time and connections between ice-covered and open-water lake conditions. Eventually, we hope to be able to forecast lake water quality changes, if any, as ice cover continues to decrease or disappear altogether due to climate change.

Back Pond

2023 was the third year we visited Back Pond in winter. The temperature profiles indicated mixed conditions between two and five meters, and little changed in most of the water column during the two weeks between visits. Dissolved oxygen (DO) decreased with depth and time, particularly in the deeper waters. A DO peak just under the ice in early February corresponded with a peak in chlorophyll fluorescence (this indicates algae growing and producing oxygen). The fluorescence peak deepened and decreased by the next visit. Secchi, phosphorus, and chlorophyll-a were all near the long-term averages. The initial lower-than-average Secchi depth on Feb 10 aligned with the slightly higher phosphorus and chlorophyll-a concentrations.

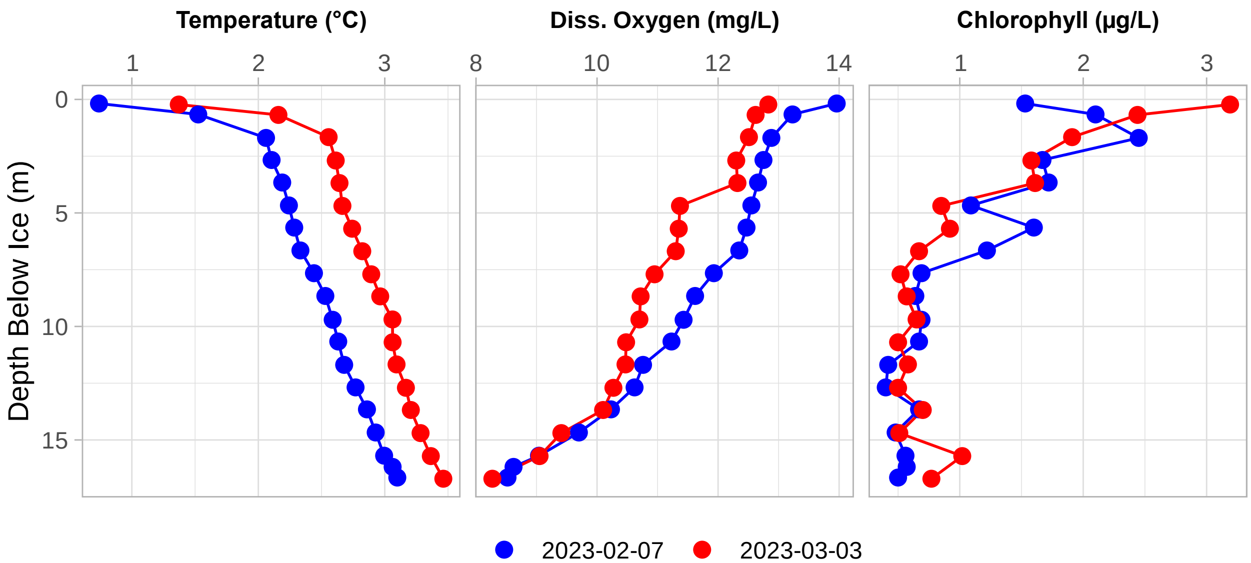


Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-10	5.25	6.7	1.5
2023-02-22	7.25	5.9	1.2
1996–2022 Average (Min–Max)	6.53 (4.44–8.74)	6.0 (3.0–16)	2.1 (0.90–5.2)

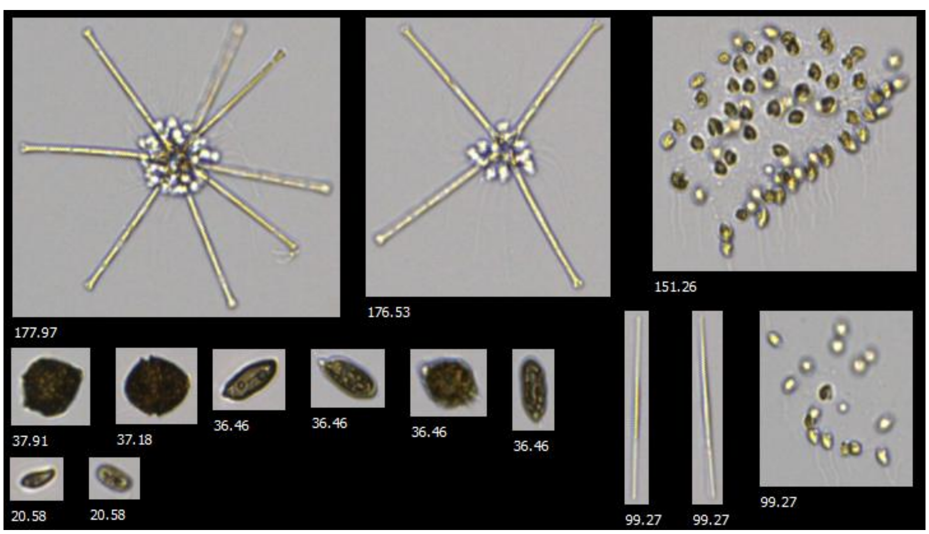
Example FlowCam images captured during runs of Back Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, cyanobacteria, dinoflagellates, and synurophytes.

Hancock Pond

2023 was the third year we visited Hancock Pond in winter. The basic patterns in the sonde profiles were the same as the previous two years. The slow rise in water temperature indicated a relatively stable water column that gradually heated over the three weeks between trips and never quite reached 4 °C (39.2 °F). Dissolved oxygen decreased with depth and only slightly with time in the middle of the water column, but the water remained well-oxygenated to the bottom. Chlorophyll fluorescence was elevated near the ice and decreased with depth. Secchi depth, phosphorus, and chlorophyll-a were below, above, and below long-term averages, respectively.



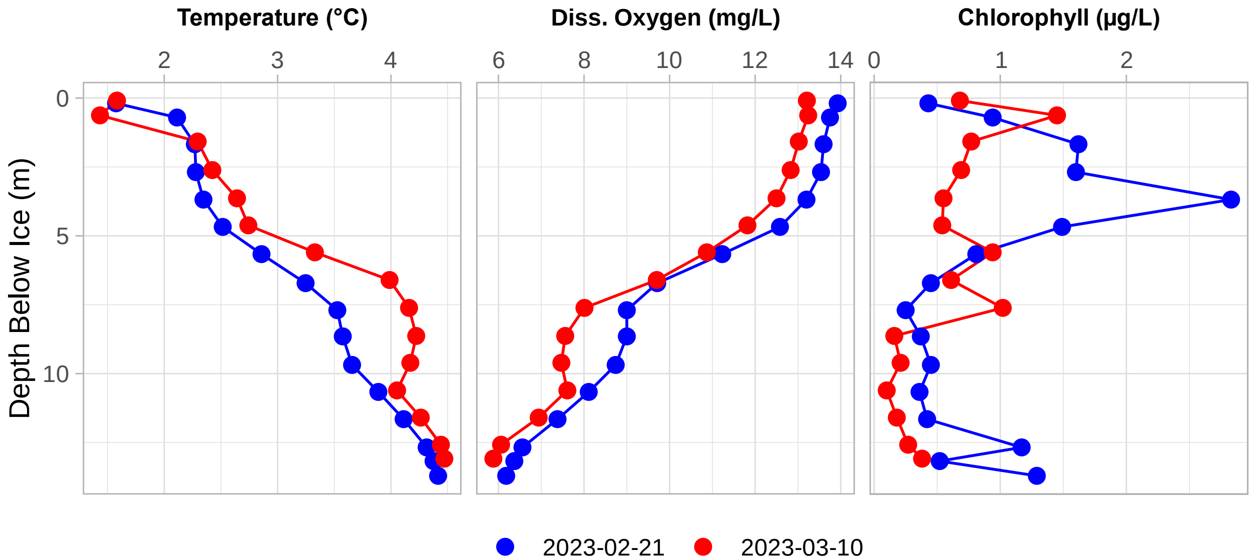
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-07	5.75	6.9	2.0
2023-03-03	5.35	6.3	2.0
1996–2022 Average (Min–Max)	7.15 (4.6–8.95)	5.7 (3.0–14)	2.8 (1.0–6.0)



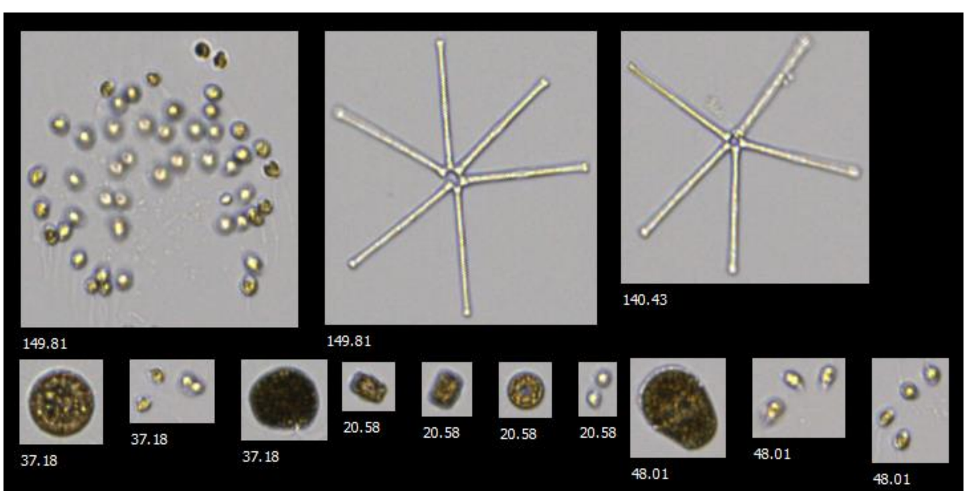
Example FlowCam images captured during runs of Hancock Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, crysophytes, diatoms, and dinoflagellates.

Highland Lake

Winter visits to Highland Lake have continued since the first trip in 2018 except for 2021. Some of the same patterns seen in previous years' sonde profiles were evident in 2023. Water temperature increased in a stair-step pattern indicating various zones of mixing or circulation. The unusual bump in temperature (and drop in oxygen) at depths between 7 and 10 m in March suggest that there may have been horizontal movement of warm, dense water from shallower areas. Bottom waters exceeded 4 °C (39.2 °F) on both visits. Dissolved oxygen decreased with depth, but the water column remained oxygenated throughout. Chlorophyll fluorescence showed an algae peak at about 4 m depth. Secchi depth, phosphorus, and chlorophyll-a were all at or below long-term averages.



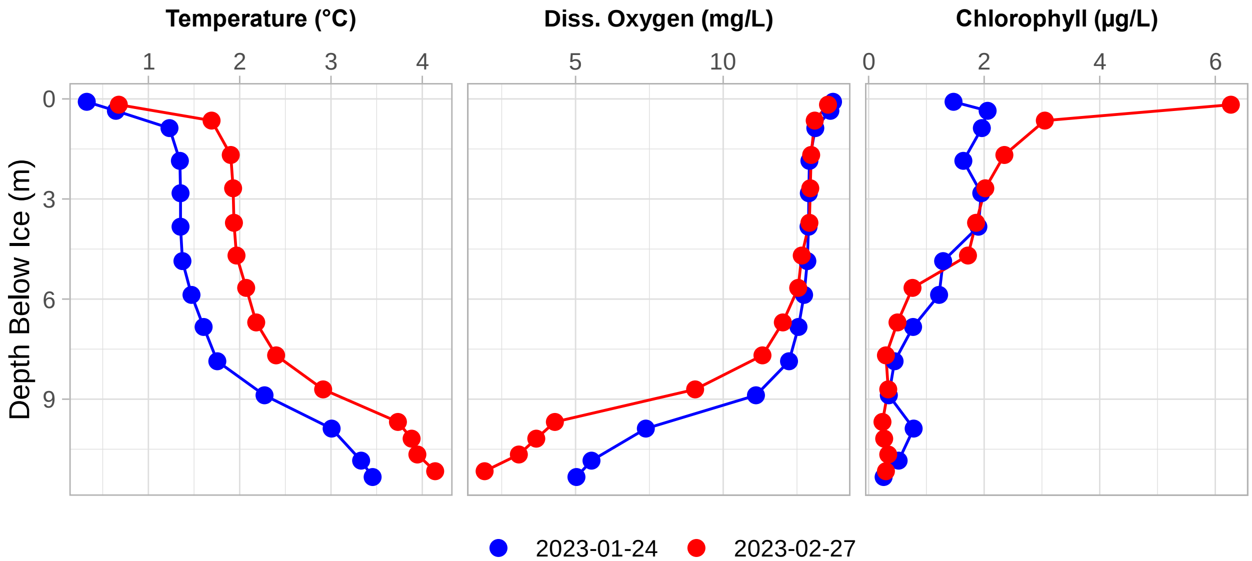
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-21	6.52	6.3	1.8
2023-03-10	6.08	4.4	1.2
1996–2022 Average (Min–Max)	6.86 (4.80–9.40)	6.4 (3.0–20)	2.8 (1.0–10)



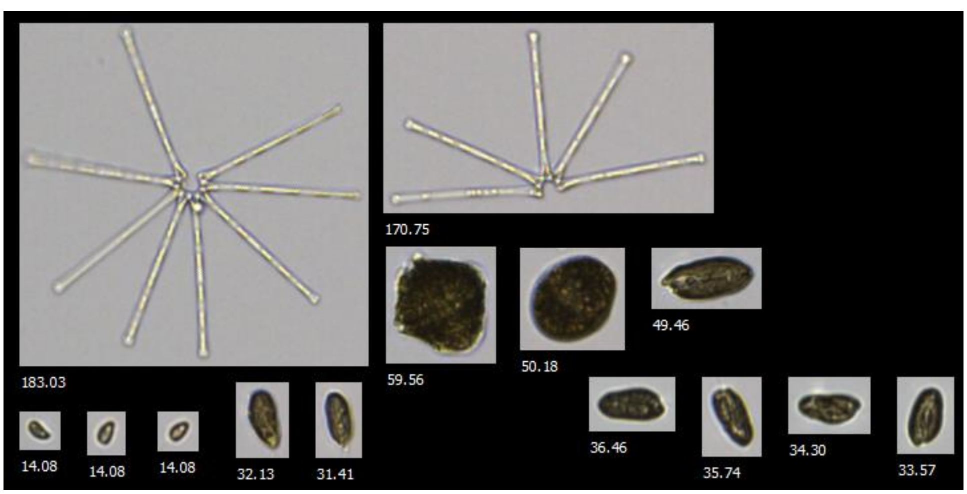
Example FlowCam images captured during runs of Highland Lake samples. Numbers indicate length in micrometers. Taxa include crysophytes, diatoms, and dinoflagellates.

Keoka Lake

We visited Keoka Lake in the winter for the fifth consecutive year in 2023. The sonde profile patterns stayed basically the same. Temperatures increased over the month between visits, though the profile shape stayed the same; the water column appeared to be mixed down to 7 m. Dissolved oxygen decreased in deep water, which became hypoxic (low oxygen) by March. Based on the previous year, bottom waters were probably anoxic by ice-out. Chlorophyll fluorescence was elevated in the upper 4 m, and a large under-ice peak (indicating significant algae growth) was evident at the end of February. Water clarity was lower than average and phosphorus was higher than average, but chlorophyll-a remained low.



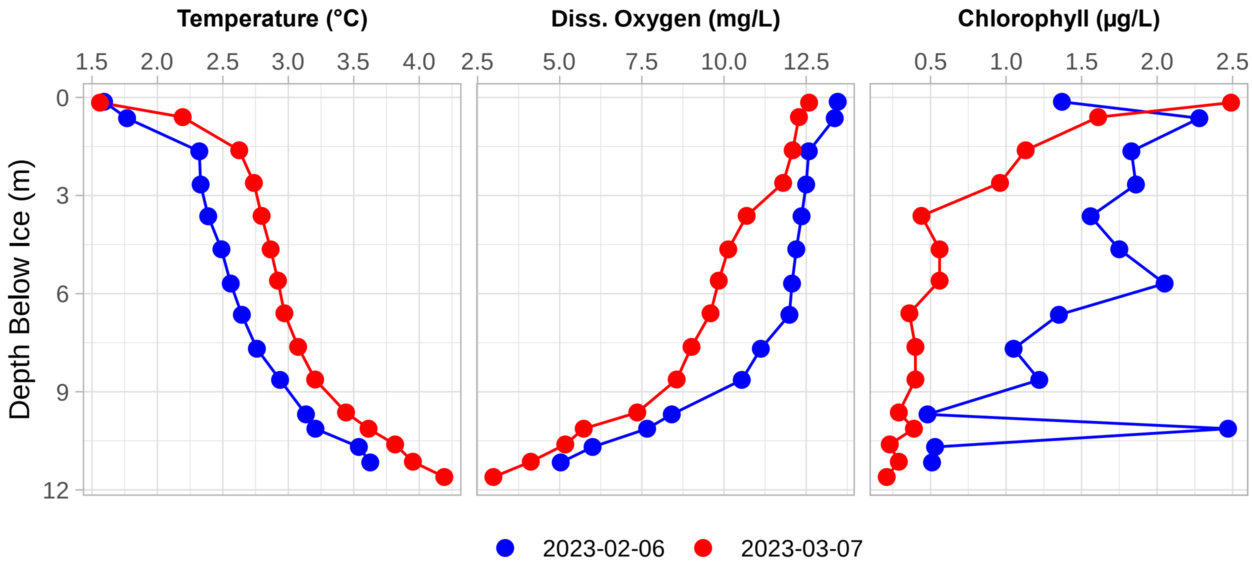
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-01-24	3.99	10.2	1.0
2023-02-27	4.50	9.5	1.4
1996–2022 Average (Min–Max)	6.02 (3.50–8.20)	7.5 (3.0–16)	3.6 (0.90–10)



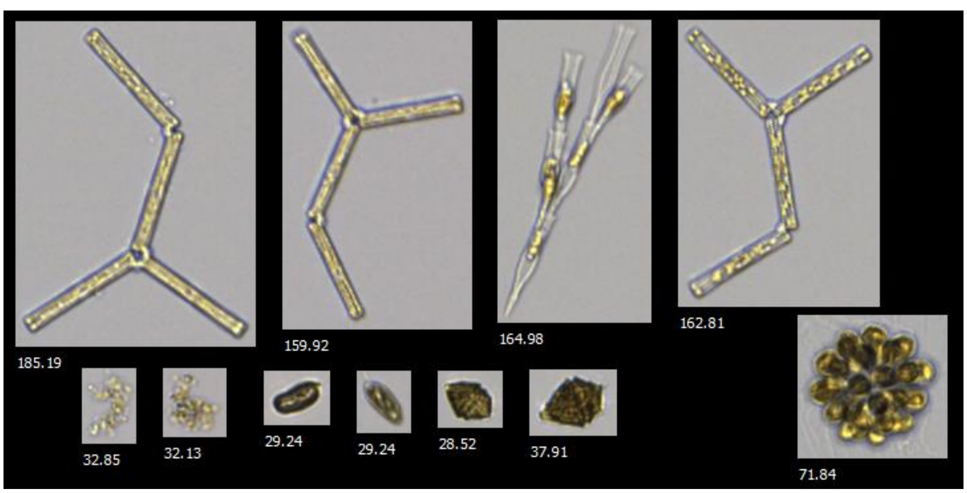
Example FlowCam images captured during runs of Keoka Lake samples. Numbers indicate length in micrometers. Taxa include cryptophytes, diatoms, and dinoflagellates.

Keyes Pond

This was the third year we visited Keyes Pond in winter. Unlike in 2022, temperature showed a gradual increase with depth indicating more stable conditions. Over the month between visits, temperature increased and only reached 4 °C (39.2 °F) at the bottom. Dissolved oxygen decreased with depth and with time, reaching near-hypoxic (low oxygen) levels; bottom waters probably became anoxic (no oxygen) based on 2021 conditions. Chlorophyll fluorescence decreased with depth from a peak just under the ice in March, however the February profile was much more variable. Water clarity was lower than average and phosphorus was higher than average, but chlorophyll-a remained low.



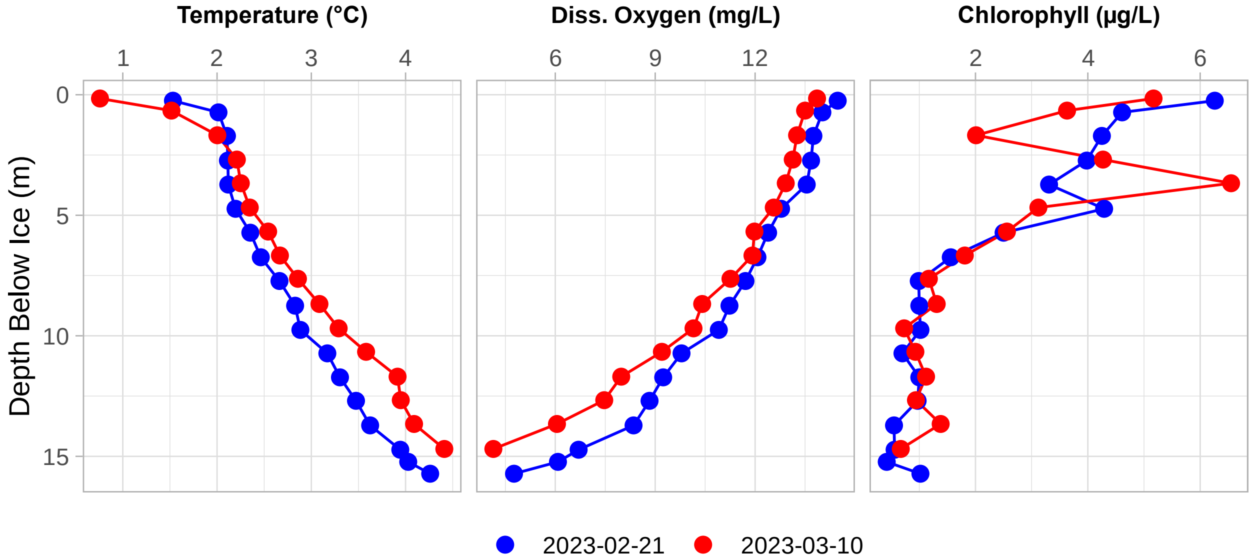
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-06	3.99	10.2	1.0
2023-03-07	4.50	9.5	1.4
1996–2022 Average (Min–Max)	6.24 (3.20–8.11)	7.1 (3.0–12)	3.3 (1.0–11)



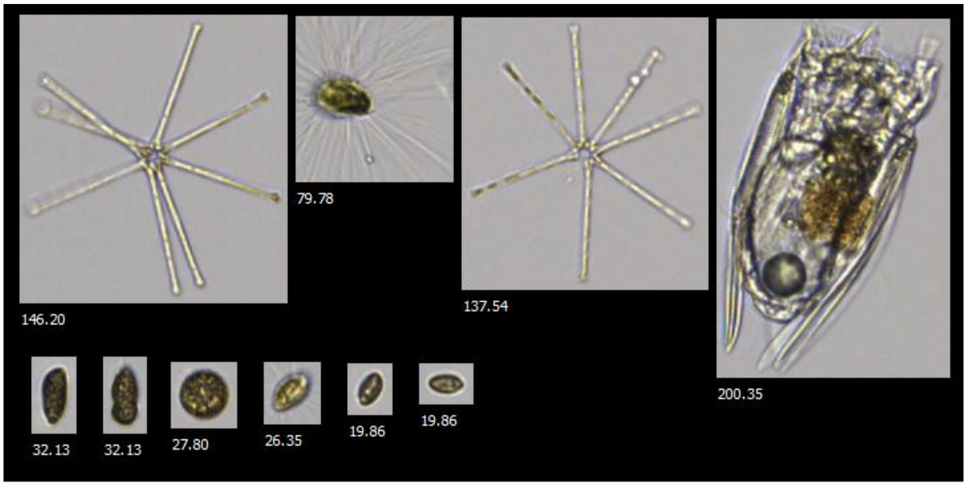
Example FlowCam images captured during runs of Keyes Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, crysophytes, cyanobacteria, diatoms, and dinoflagellates.

Long Lake-North Basin

2023 was the second year we visited Long Lake in winter. As in 2022, the water column was stable and temperatures increased gradually with depth and slightly over the two and half weeks between trips; only the bottom meter reached 4 °C (39.2 °F) and above. Dissolved oxygen decreased steadily with depth and slightly with time, but the water remained oxygenated to the bottom. Chlorophyll fluorescence began high near the ice and declined gradually with depth, except for a peak at about 4 or 5 m. Water clarity was lower than average, and both phosphorus and chlorophyll-a were close to the long-term average.



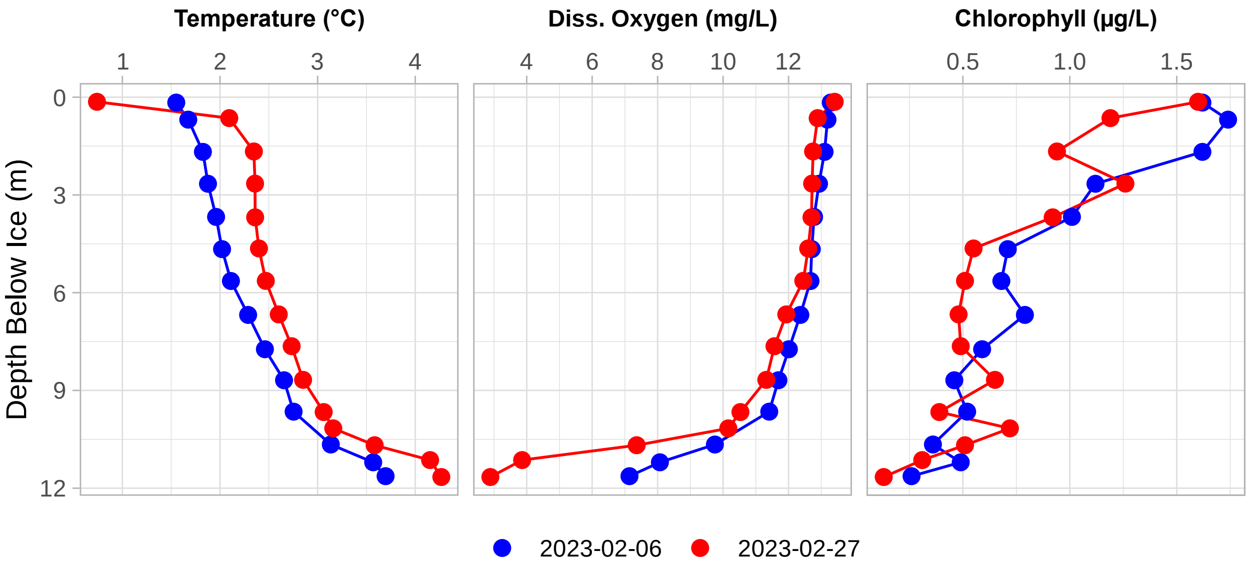
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-21	4.50	7.6	2.6
2023-03-10	4.58	7.0	2.6
1996–2022 Average (Min–Max)	6.19 (4.00–8.62)	7.3 (3.0–19)	3.0 (1.0–8.7)



Example FlowCam images captured during runs of Long Lake samples. Numbers indicate length in micrometers. Taxa include cryptophytes, diatoms, and synurophytes. A rotifer is shown as well.

McWain Pond

2023 was the third year we visited McWain Pond in winter. The water column was stable based on a gradual temperature increase with depth. By the second visit, overall temperature increased and constant temperature between 1.5 and 4 m indicated some mixing. Dissolved oxygen (DO) decreased with depth and slightly with time. Even though the bottom water remained oxygenated, DO was the lowest yet over the three years. Chlorophyll was generally low and declined with depth. Secchi depth was about average on the first visit and below the long-term average by a meter on the second. Phosphorus was a bit above average, and chlorophyll-a was below average and even lower than the long-term minimum.

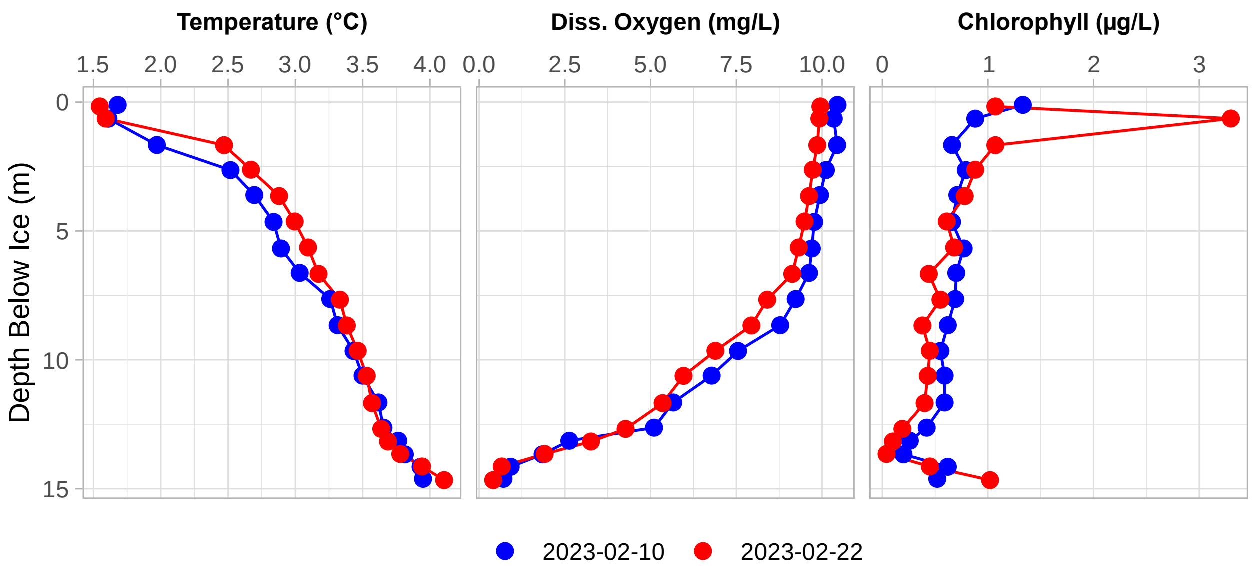


Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-06	6.12	7.6	0.92
2023-02-27	4.96	7.8	0.71
1996–2022 Average (Min–Max)	6.03 (3.40–7.90)	7.0 (1.0–19)	2.9 (1.0–6.0)

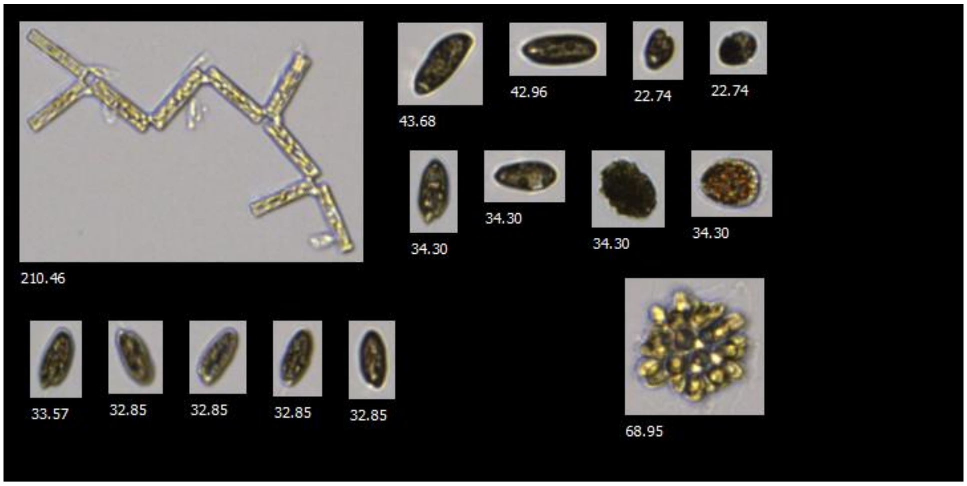
Example FlowCam images captured during runs of McWain Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, cyanobacteria, and diatoms.

Middle Pond

We made winter visits to Middle Pond for the third time in 2023. The sonde profiles changed little between years and visits, except for a gradual temperature increase with depth this year that signified stable conditions. Dissolved oxygen decreased slightly with time and rapidly with depth, reaching anoxic (no oxygen) conditions (0 mg/L) at the bottom (the only lake to do this). Chlorophyll fluorescence decreased with depth and was low except for moderate peaks within one meter of the ice-water interface. Water clarity was quite low and below the long-term minimum at the first visit. This low water clarity was probably driven by color instead of algae since phosphorus was about average and chlorophyll-a was well below the long-term average and minimum.



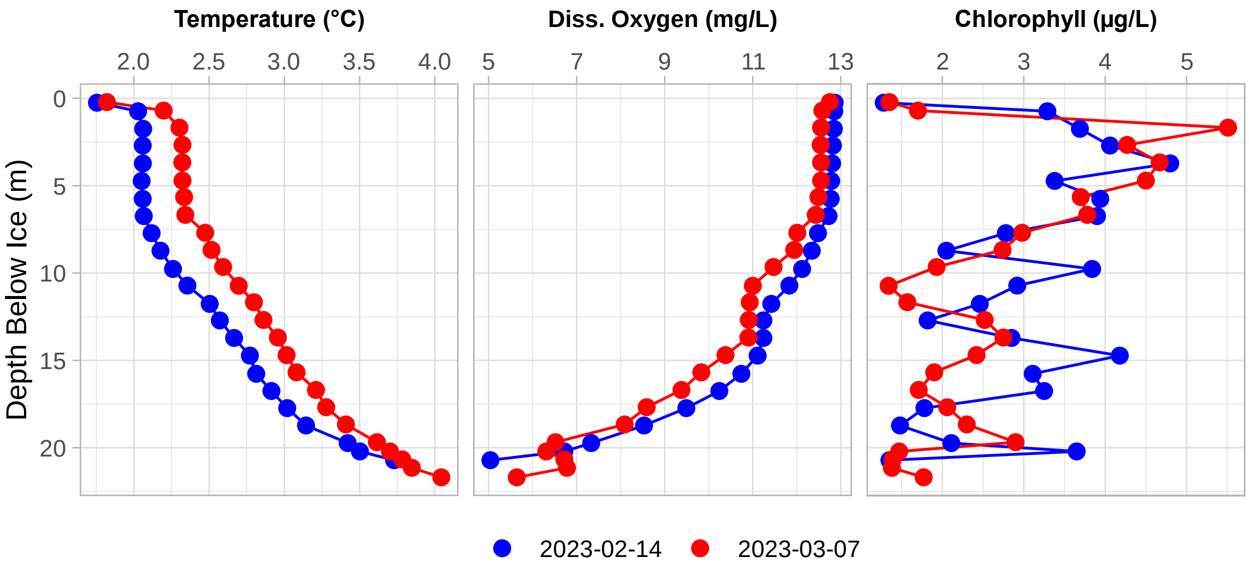
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-10	2.95	7.1	0.47
2023-02-22	3.35	7.5	0.48
1996–2022 Average (Min–Max)	5.44 (3.10–7.79)	7.5 (3.0–19)	3.4 (1.0–15)



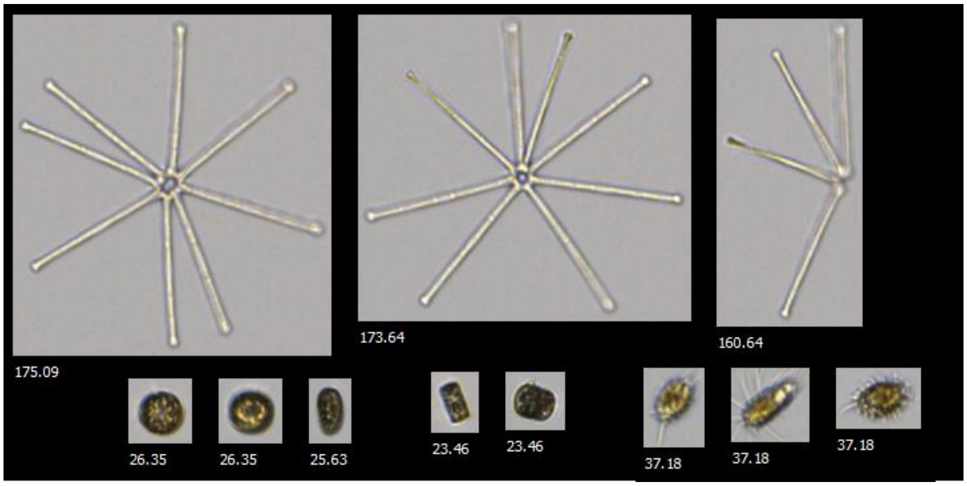
Example FlowCam images captured during runs of Middle Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, diatoms, dinoflagellates, and synurophytes.

Moose Pond-Main Basin

2023 was the third year we visited Moose Pond in winter. Based on the temperature profiles, the upper seven-meter layer was mixed, while below that the gradual change with depth indicated more stable conditions. Temperatures increased about 0.5 °C in the three weeks between visits. Dissolved oxygen decreased with depth and also with time. Concentrations reached as low as 5 mg/L, which is the threshold needed for most fish, but the deep water never went anoxic (no oxygen). Chlorophyll fluorescence was moderate and quite variable throughout the water column, though peak values were in the upper two to three meters. Secchi depth was quite low compared to the long-term average and minimum, while phosphorus and chlorophyll-a were at or just below average concentrations.



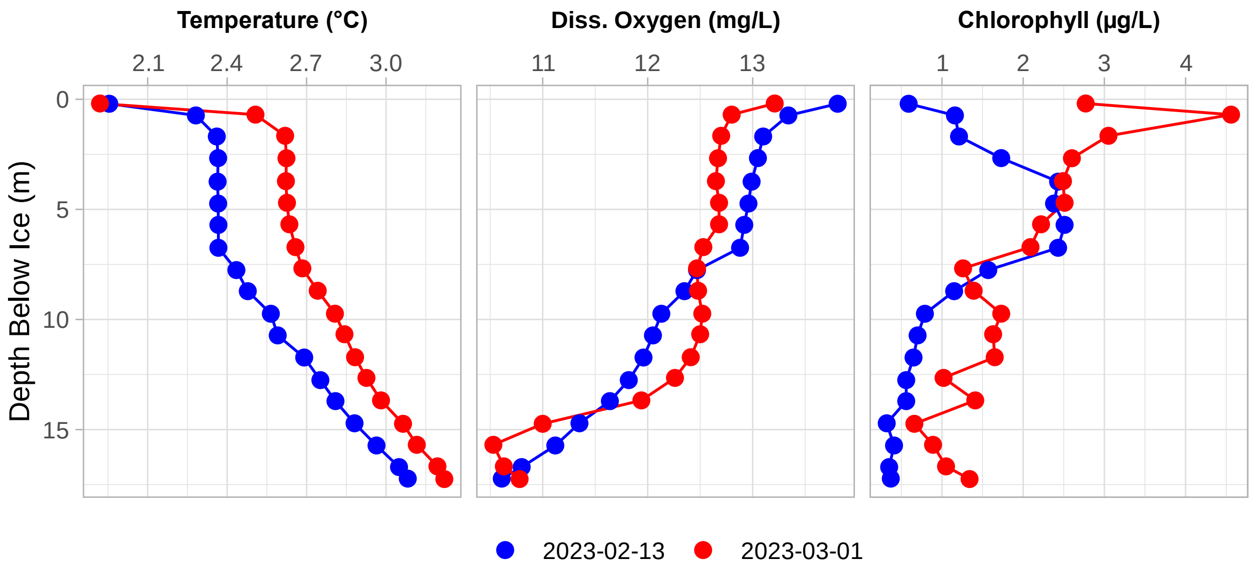
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-14	5.70	6.1	2.5
2023-03-07	4.18	5.1	2.3
1996–2022 Average (Min–Max)	7.45 (4.52–10.20)	5.7 (3.0–13)	2.9 (1.0–10)



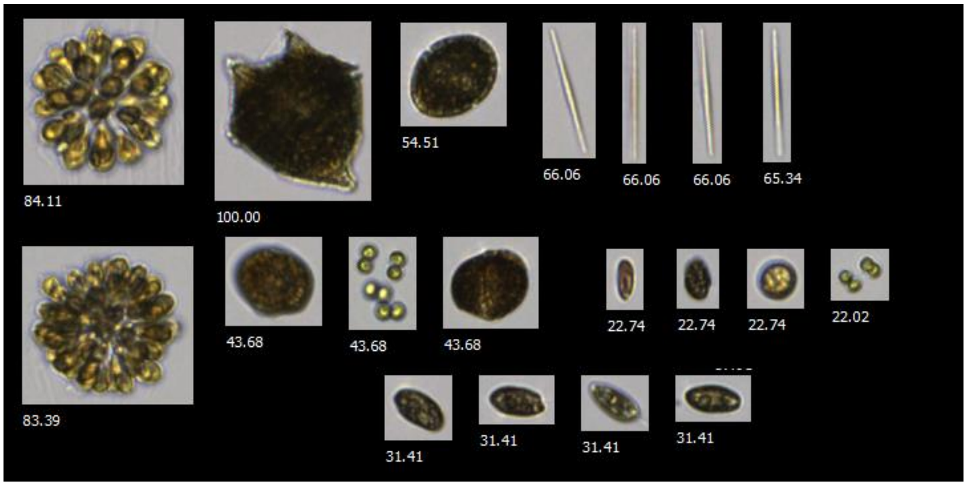
Example FlowCam images captured during runs of Moose Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, diatoms, and synurophytes.

Peabody Pond

We visited Peabody Pond in winter for the third time in 2023. The sonde profiles were remarkably similar to those collected in the previous two years. Temperature increased slightly between trips and was constant from two to seven meters, which meant mixed conditions. Below that, the gradual temperature increase indicated more stable conditions. Dissolved oxygen (DO) decreased with depth and somewhat with time, but the water remained fully oxygenated to the bottom. Chlorophyll fluorescence was low to moderate with a peak on the first trip at around 5 meters that became shallower and more focused two weeks later. The combination of a slight DO bump and elevated chlorophyll around 10 m in March could mean actively photosynthesizing algae in that layer. Water clarity was somewhat lower than average, while phosphorus and chlorophyll-a were at or above the long-term average.



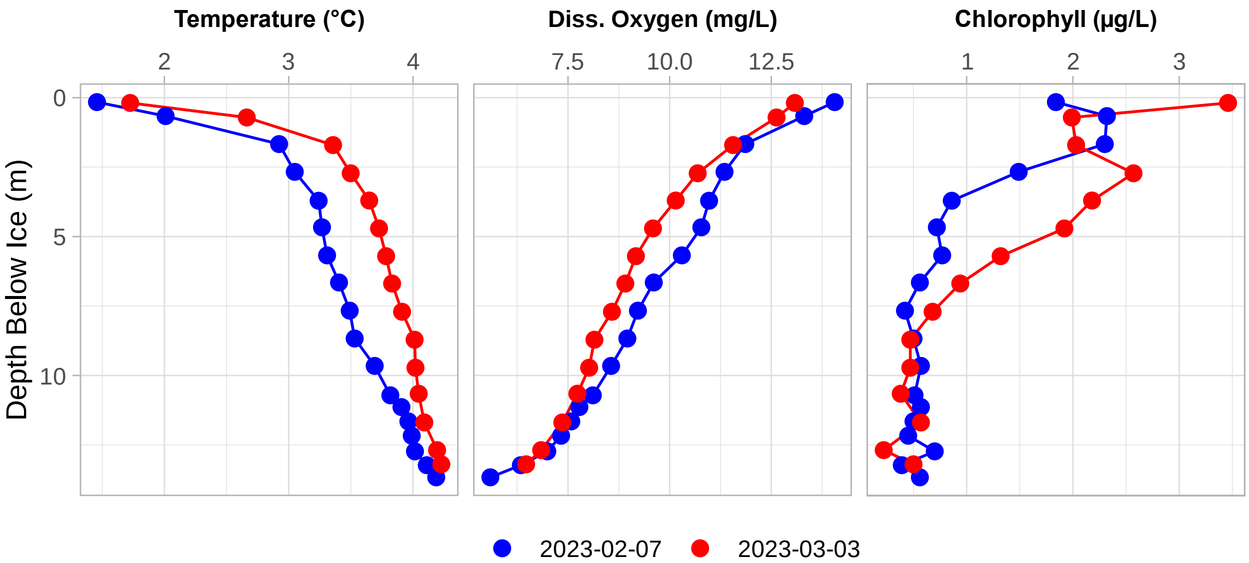
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-13	6.82	7.0	2.9
2023-03-01	5.45	5.7	2.8
1996–2022 Average (Min–Max)	7.46 (4.60–10.37)	5.6 (2.0–11)	2.6 (0.80–10)



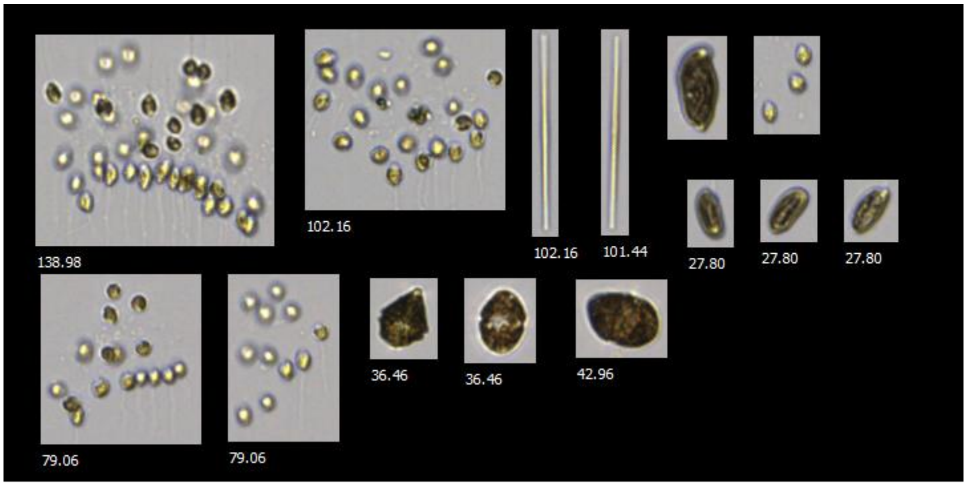
Example FlowCam images captured during runs of Peabody Pond samples. Numbers indicate length in micrometers. Taxa include chlorophytes, cryptophytes, diatoms, dinoflagellates, and synurophytes.

Sand Pond

In 2023, we visited Sand Pond in winter for the sixth consecutive year. The water column was relatively stable based on the gradual increase in temperature with depth. Profiles from the previous two years showed much less change with depth (i.e., more mixed conditions). Much of the lake water warmed by about 0.5 °C in the month between visits. Dissolved oxygen decreased with depth and with time at middle depths, but the water column remained oxygenated on both visits. Chlorophyll fluorescence decreased from elevated readings in the upper two meters to fairly low levels at depth. Winter Secchi depths were lower than average and in March lower than the long-term minimum. This low water clarity could not be explained by high phosphorus or chlorophyll, which were the same or lower than average.



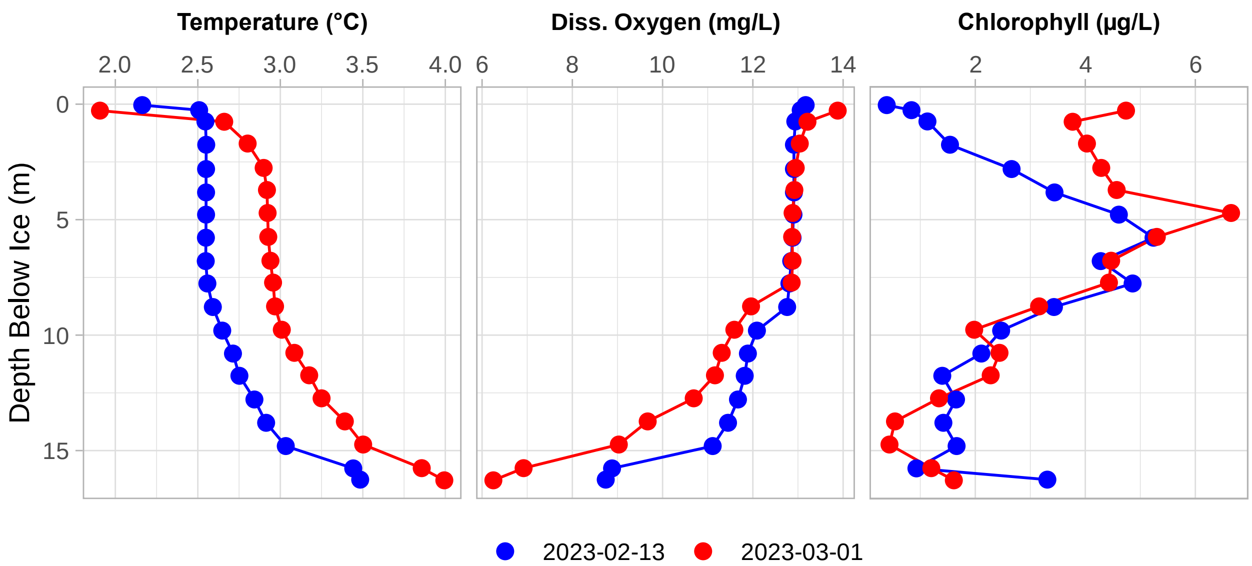
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-07	5.72	8.5	1.5
2023-03-03	3.68	7.0	1.9
1996–2022 Average (Min–Max)	6.19 (4.00–8.70)	8.2 (5.0–26)	3.4 (1.2–9.0)



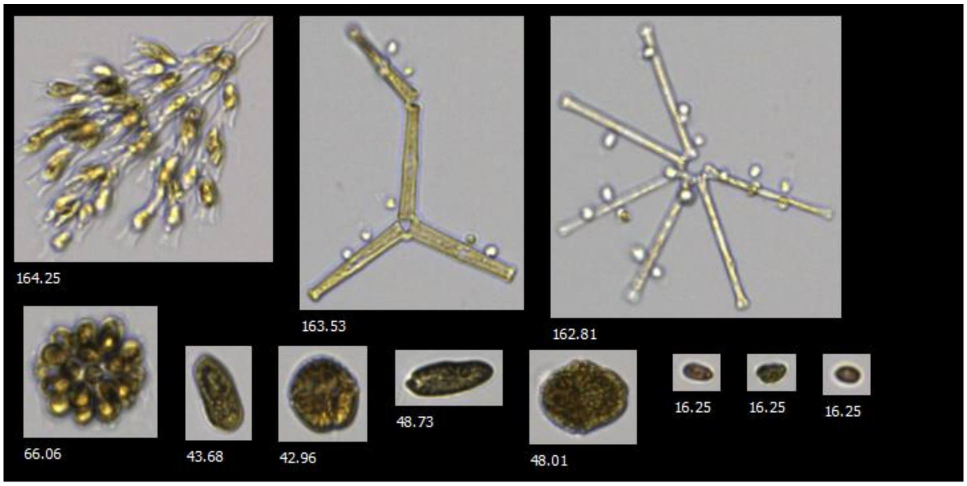
Example FlowCam images captured during runs of Sand Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, crysophytes, diatoms, and dinoflagellates.

Trickey Pond

This was the fourth consecutive year that we monitored Trickey Pond in the winter. As in 2022, temperature increased with time and depth, except in the three to eight meter layer where constant temperatures indicated mixing. Dissolved oxygen decreased with depth and slightly with time, but the water column remained completely oxygenated on both visits. Chlorophyll fluorescence was quite elevated in mid-depth waters; that peak was confirmed by the higher-than-average extracted chlorophyll-a on both dates. Both Secchi depth readings were lower than average, but the March value was even below the long-term minimum. The above-average chlorophyll-a indicated algae likely reduced water clarity during both visits. Phosphorus was also somewhat higher than average.



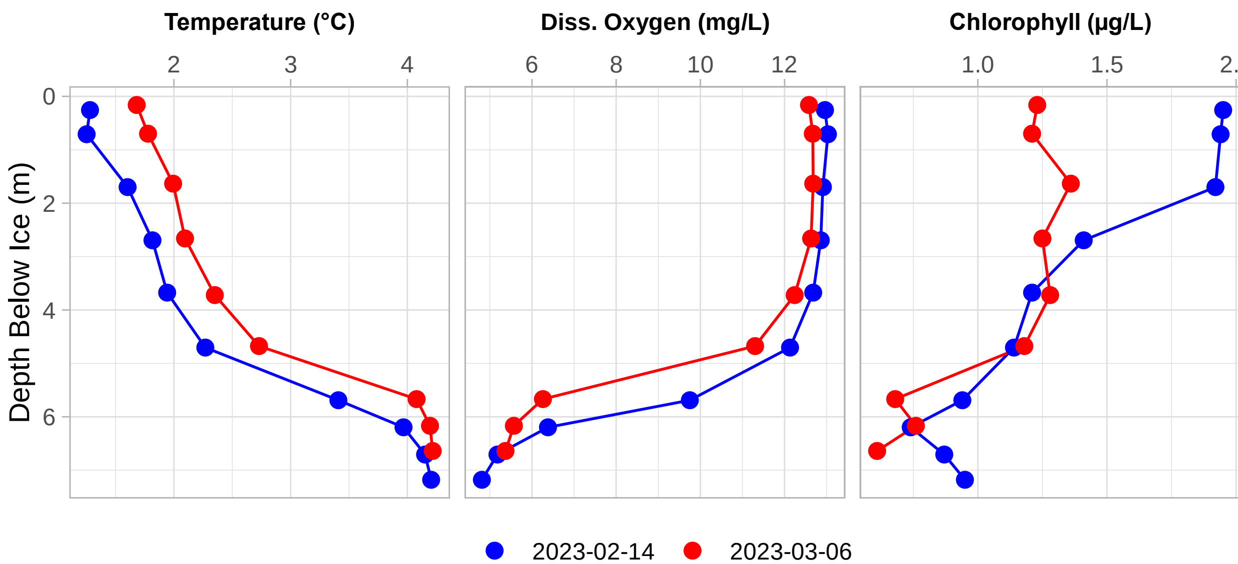
Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-13	8.50	7.4	4.0
2023-03-01	6.35	5.8	5.9
1996–2022 Average (Min–Max)	10.01 (6.40–14.70)	5.2 (2.0–10)	1.8 (0.47–6.7)



Example FlowCam images captured during runs of Trickey Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, crysophytes, diatoms, dinoflagellates, and synurophytes.

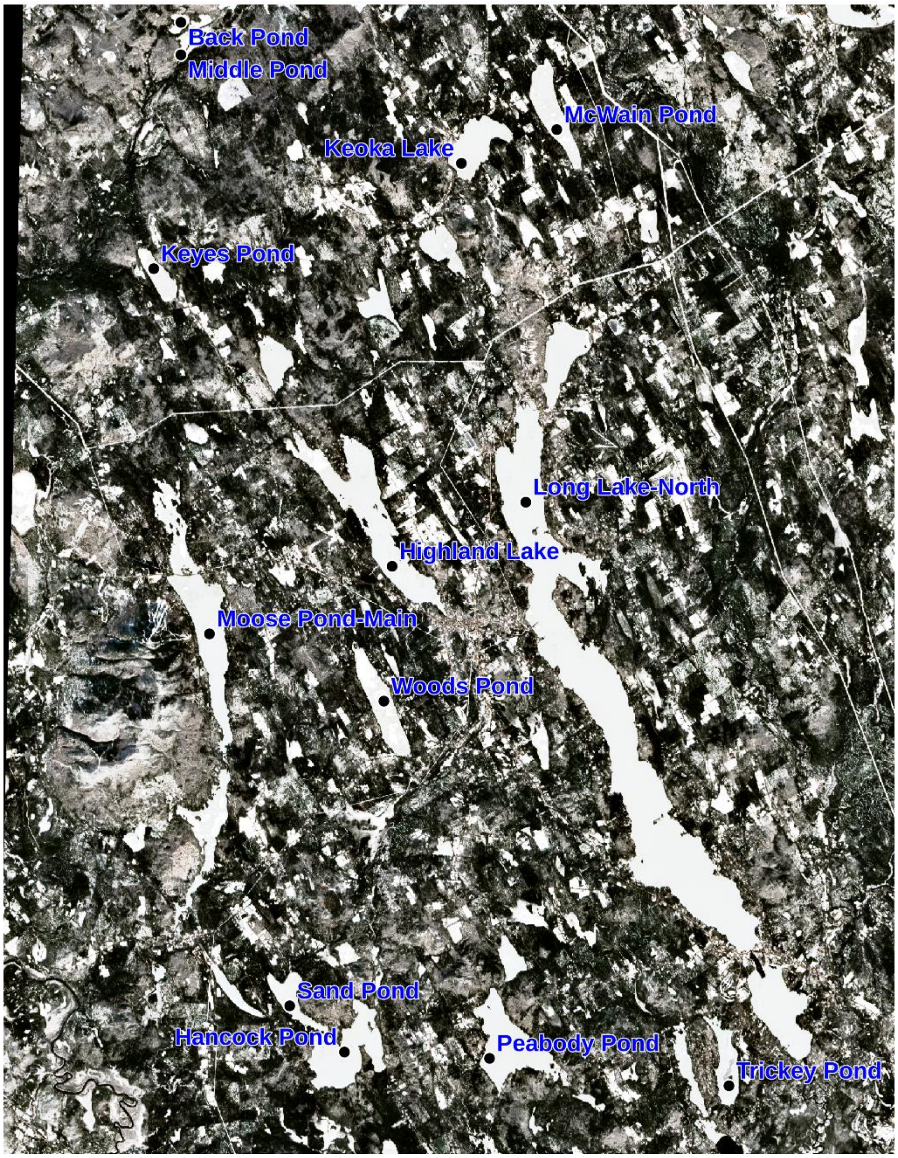
Woods Pond

In 2023, we visited Woods Pond in winter for the fourth consecutive year and many of the patterns remained the same. Temperature increased gradually with depth and only slightly in the three weeks between trips. Most of the water column appeared to be stable because of the temperature pattern. Dissolved oxygen decreased with depth and time, but the water column remained completely oxygenated on both visits. Chlorophyll fluorescence was low to moderate in the top meter or two and decreased with depth. Secchi depths were below average and as low as the long-term minimum in March; total phosphorus and chlorophyll-a concentrations were all below the long-term averages. Water color probably caused the low water clarity rather than algae.



Collection Date	Secchi Depth (m)	Total Phosphorus (ppb)	Chlorophyll-a (ppb)
2023-02-14	4.50	7.4	1.1
2023-03-06	2.98	6.1	0.46
1996–2022 Average (Min–Max)	5.01 (3.00–7.50)	8.0 (4.0–16)	3.0 (1.0–11)

Example FlowCam images captured during runs of Woods Pond samples. Numbers indicate length in micrometers. Taxa include cryptophytes, diatoms, and synurophytes.



Winter monitoring locations shown on top of Sentinel-2 satellite imagery from 2023-2-11

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If you have any questions about this report or its content, or would like to share your thoughts, please contact Ben Peierls: ben@mainelakes.org